Summary of work done

C.Y. Tan
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Status of PSP projects

MachineStu	Description	People	Status
Pre-Acc	Improve neutralization in LEBT with N or Xe.	Kiyomi/Dan/ Pat	To be continued in 2021
Pre-Acc	Penning source and test stand	Dan/Pat	Penning source installed under rough vacuum. New postdoc (D. Jones) hired to work on this
Pre-Acc	Laser collimation of head/tail of longitudinal beam. (LDRD)	Dave	Ready but waiting for tier2 covid status
Pre-Acc/Linac	Simulation of PreAcc + Linac	Valeriy/Kiyomi/Dan	Permanent magnets being considered.
Pre-Acc/Linac	Re-aligned PreAcc	Kiyomi/Dan/Pat	Realigned during shutdown
Linac	Klystron testing	Kiyomi	4 good, 2 bad. 1 on test stand. 1 waiting to be tested.
Booster	Flat injection porch	Kiyomi/Bill/George/ Howie/Chris	To be continued in 2021
Booster	Lattice studies	Jeff/John J	To be discussed today
Booster	Adiabatic capture	Chandra/Tan	To be continued in 2021
Booster	2nd harmonic	Robyn/Tan	First repair done. More modifications on the way.
Booster	Wide bore cavity	John/Robyn	Has been tested but cannot reach frequency range. Tuner needs to be modified. Simulations done.
Booster	2 stage collimators	Valeriy/Chandra	Installation in 2022.
Booster	Injection girder and injector civil construction to Booster	Dave/Salah/ Tan	E4R test stand install continues. Civil construction: company will start drawings in Jan 2021.
Booster	Garnet loss improvements	Robyn/Tan/Iouri/ Gennady	Garnet type A received. Winding of solenoids of test fixture at TD.
Booster	Mode 2 & new longitudinal dampers	Bill/Nathan	Commissioning continues for both systems. Waiting for high intensity operations
LLRF	GMPS machine learning (get rid of reference magnet)	Bill/Brian/Kiyomi	Firmware work continues. Gathering data for ML. Waiting for chassis.
LLRF	Complete DDS upgrade, paraphase controller	Brian/Ed	**Completed. Operational!!!!**
LLRF	Phase feedback, radial feedback	Brian/Ed/Bill/Tan/ Valeri/Craig	Work continues. Hardware continues to be built. Firmware being programmed. Theory of LLRF being worked on.

Task force updates (cont'd)

- Tall aperture gradient extraction magnets
  - See injection girder about the problem with GMPS with non-identical D magnets.
  - Calculation for gap size first pass says about +/- 5 mm required. However, needs benchmarking with current operations.
- 20 Hz cavity tests
  - Report is being written. Status?
- 50 kV in situ cavity test. Required for PIPII
  - Plan is to run continue some cavities at 50 kV once we are back to regular HEP running.
- BTL to L11 changes
  - Addition of collimators into the transfer line. Booster style 2 stage in BTL line.

Task force updates

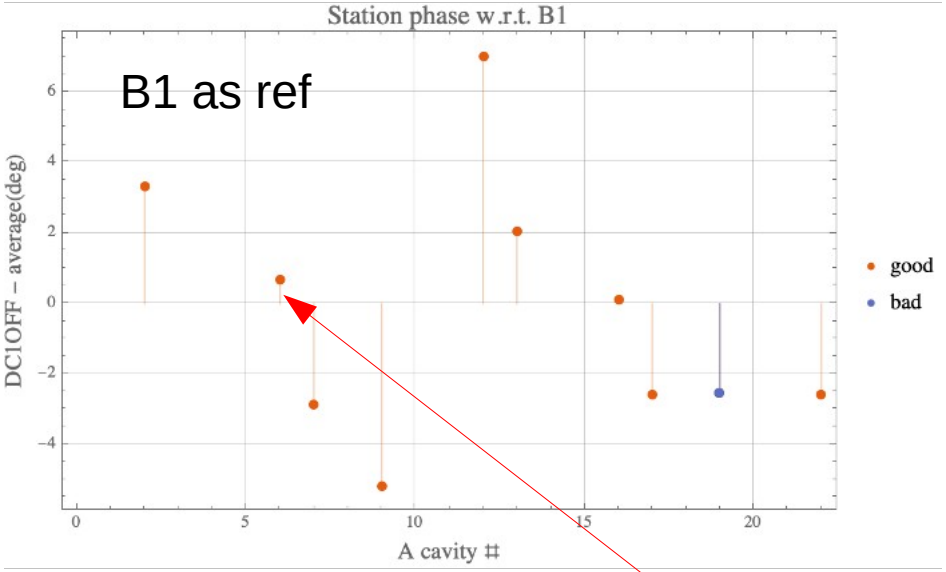
- RF phasing experiments show a possible problem.
  - Beam measurements show that phase difference between B1 & A6 is ~40 deg for anti-phase at 39.76125 MHz and 168 MHz at 37.95375 MHz (normal inj freq)! Something is wrong here.
  - Measurements upstairs to check that cable lengths are correct. Analysis continues.
- Transition crossing – group was formed. Led by Chandra.
- Injection girder
  - Talked to Dan Wolf and Howie Pfeffer, we will have to do a SPICE calculation as to whether there will be an “imbalance” (transmission line modes) that will shake the beam because of the addition of 4 D magnets that are not identical to the D magnets in Booster. (30 and 31 Oct 2019)
  - Absorber review (20 Nov 2019) https://indico.fnal.gov/event/22416/
- Magnet girder tests
  - E4R test stand installation will continue in 2021.
- 20 Hz infrastructure (see next slide)
  - First test done in 16 Sep 2020

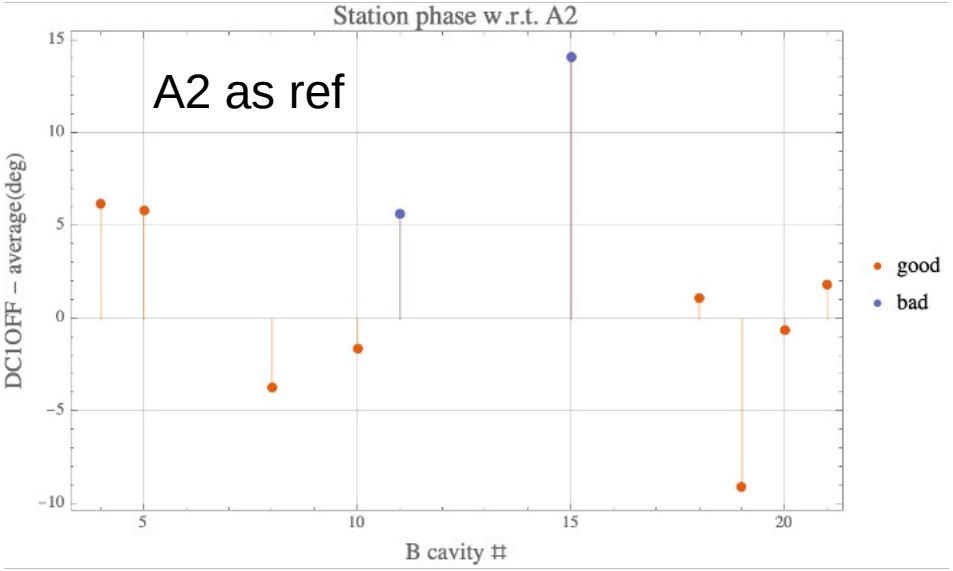
20 Hz test (16 Sep 2020) summary

System	Works at 20 Hz?	Comments
Booster BPMs	Does not work. Hard coded 15 Hz in timing boards	2 months of work to modify system -- Peter Prieto
Booster correctors	Works, at least the reference follows higher rate	Need PS on to really know whether PS follow reference.
Booster BLMs	Works	Returns zero, so hard to tell if there are problems.
Booster LLRF	Does not work. Hard coded 15 Hz in accelerator phase module	Will be taken care of with Booster LLRF digital upgrade
Cogging and BES	Does not work. Hard coded 15 Hz.	Will be taken care of with Booster LLRF digital upgrade or upgrade of present module
GMPS	Does not work. Hard coded 15 Hz	Will be taken care with LDRD GMPS upgrade.
CUB	Unknown if CUB has enough capacity to handle 20 Hz load	See D. Hixson's talk today
MOOC VME FEs	Data returned at 20 Hz	Limited test
TLG	Works	Time line & module calculations completed for the test
UCDA/UCDB	No	Timestamps in MI/RR wrong
Data loggers	Yes	Some data loggers were checked at 20 Hz
Network traffic	Yes	Monitored during the test

Note: this is a first pass of tests. More tests in 2021

RF phase measurements

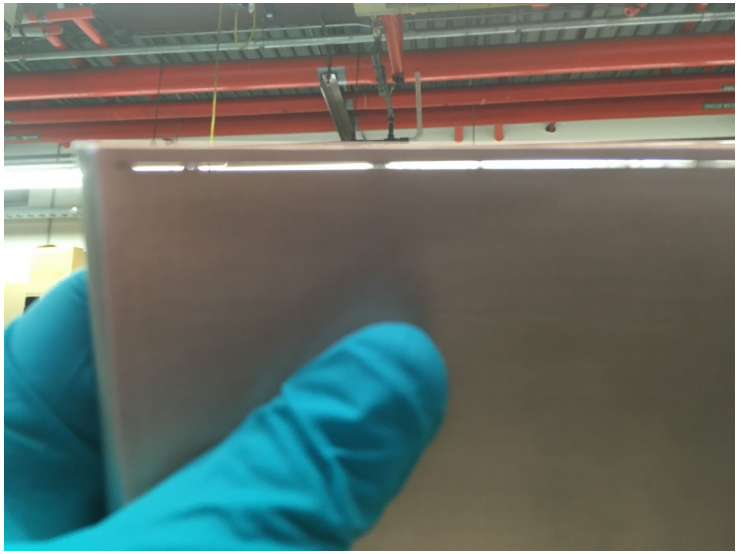




DC ramp: Only 2 stations are on. A and B stations should voltages cancel. “bad’ means the discrepancy between cavity modulator amplitudes is significant because we could not cancel them by adjusting the paraphase angle between stations (B:DC1OFF)

BUT with 2 frequencies (37.96375 MHz & 39.76125 MHz) , more problems were revealed:
Although B1&A6 cancel at 167 deg@37.96375 MHz, they cancel at 40 deg@39.76125 MHz!
Expect ~180 deg for both frequencies.

2nd harmonic plate repair

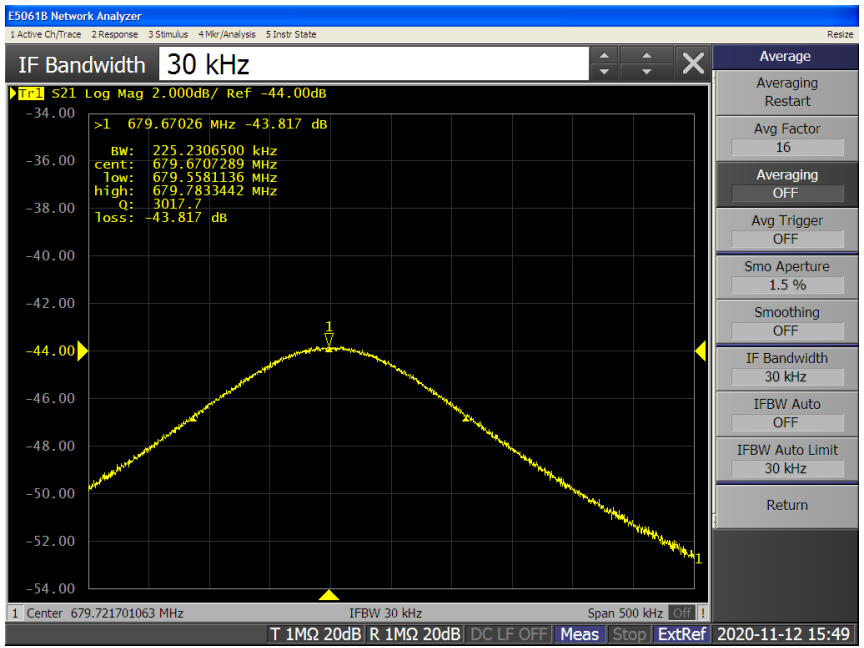


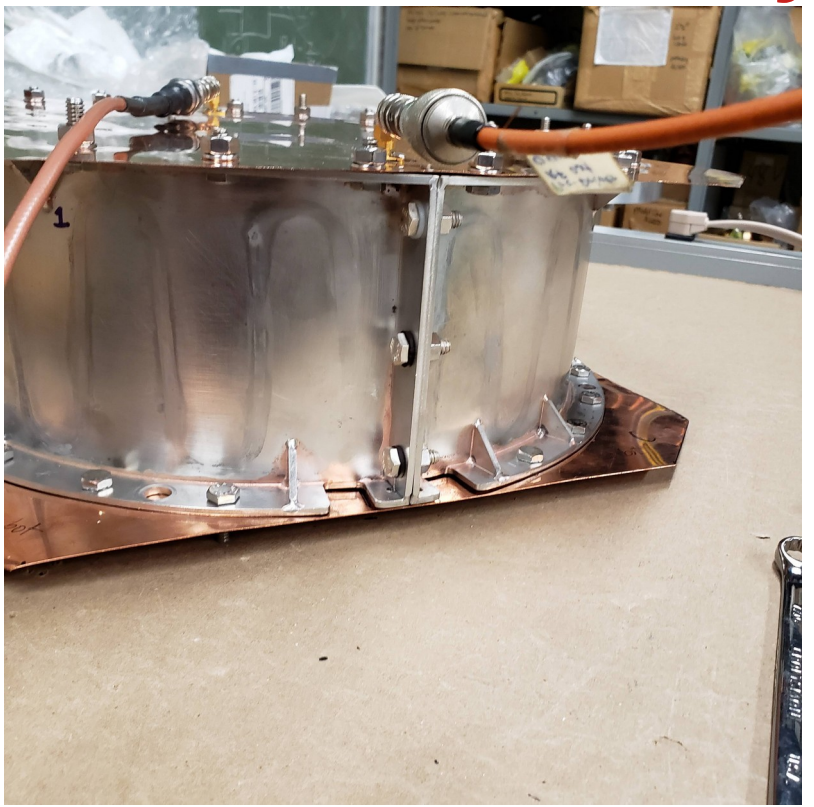
Cracks before brazing

Cracks filled with braze

We plan to replate so that the braze joints are covered with copper plating.

Repair improved Q of Pillbox cavity





Pill box cavity was built with the shells. Q improved from 500 to 3000 – 4000. There will be further modifications. End plates will also be brazed on.